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der his accounts of such disbursements in accordance with the rules and instructions to carry into effect the Executive order of May 8, 1899, relative to the military government of the United States in the Islands of the Philippine Archipelago during the maintenance of such government.

WILLIAM McKINLEY.

[Under the above Executive order, P. A. Surg. James C. Perry, who has been temporarily acting as chief quarantine officer, has been duly detailed as chief quarantine officer of the Philippine Islands.]

SOME OBSERVATIONS UPON THE PLAGUE AT OPORTO—VIABILITY OF THE PLAGUE BACILLUS IN SPUTUM—BY DR. MÉTIN, COLONIAL MEDICAL SERVICE.

[Translated by H. D. Geddings, U. S. M. H. S., from the Annals of the Pasteur Institute, for September, 1900.]

In addition to cases of primary pneumonic plague, which is always met more or less frequently, we frequently observe in plague complications which are revealed by auscultation as being attributable to broncho-pneumonia. In both conditions the sputum of patients contains a greater or less number of the bacilli of Yersin, which are revealed either by direct preparations, by cultivation, or most easily by animal inoculation. During the fastigium of plague broncho-pneumonia the bacilli of the sputum are quite as virulent as those isolated either from the blood or from the bubo; they produce death in mice in thirty-six to forty-eight hours, and in the guinea pig in three to four days.

The question therefore presents itself of determining how long the plague bacilli may be found in the sputum, and particularly if they preserve their virulence after the patient has entered upon convalescence. We can readily see the importance of this question, for if plague bacilli remain long virulent in the sputum of convalescents, we must take special precautions against one of the most dangerous methods of dissemination of the organism.

According to Gotschlich in the experiments which he made at Alexandria (Zeitschrift fur Hygiene and Infectionskrank. XXXII, 3) virulent plague bacilli might be found in the sputum of convalescents from plague pneumonia, not only during the disease itself, but even twenty, thirty-three, and forty-eight days after complete defervescence. At Oporto we were able to study 8 patients who had recovered after having presented symptoms of plague pneumonia. Two of these patients were nurses who had contracted primary pneumonic plague while nursing in hospital patients who presented pulmonary complications in the course of an attack of the bubonic type of the disease. The six other patients had plague with buboes, situated either in the axilla or on the neck, and broncho-pneumonic symptoms declared themselves about the fourth day of the disease.

The sputum of these patients during the height of the disease, inoculated in doses of 1 c. c. into the peritoneal cavity of the guinea pig, brought about the death of the animal in three to five days, and in the organs of the animal the specific cocco-bacillus was recovered in pure culture. We were enabled to follow these patients after their cure, and to inject their sputum into guinea pigs at various intervals after the defervescence of the disease.

In spite of the richness of the sputum in various other organisms, we never hesitated to employ the intraperitoneal method of injection in all of our experiments; when the plague bacillus was still virulent the animals succumbed to plague and the microbe of Yersin was discovered pure in the organs. In the cases where on the contrary the plague bacillus was absent or had lost its virulence, the other microbes found in the sputum had no influence on the health of the animal. In all the cases we never observed any other cause of death than plague alone.

EXPERIMENTS.

I. Balieha de Lima—Bubonic plague; axillary and submaxillary buboes. Pneumonic complications showed themselves November 21, and there were numerous plague bacilli in the sputum. On November 22 a guinea pig was given 1 c. c. of the sputum in the peritoneal cavity. It died in four days of plague, confirmed by examination of the organs. The patient became convalescent on November 30, and there was no further fever after this date.

Guinea pig No. 1. On December 15, sixteen days after the defervescence of the disease, we injected 1 c. c. of the sputum into the peritoneum of a guinea pig. Two days afterwards the animal eat little, but maintained all its liveliness; there was no pain on pressure upon the abdomen; no enlarged glands, and no fever. Beginning on the third day the animal recovered its appetite, and was well on my departure from Oporto on January 20.

Guinea pig No. 2. On December 20, twenty-one days after the defervescence of the disease, a guinea pig was given in the peritoneal cavity 1 c. c. of the sputum. The guinea pig presented no departure from the normal and was left in good health.

II. Padua—Plague with submaxillary buboes: November 21, the sputum contained plague bacilli and injected into a guinea pig caused death in three days. Apyrexia dated from December 1.

Guinea pig No. 3. On December 8, seven days after defervescence, a guinea pig was injected intraperitoneally with 1 c. c. of the sputum of this patient. On the second day buboes made their appearance in both groins, accompanied by loss of appetite, abdominal pains, and fever. The guinea pig died December 13. On necropsy there were found buboes in the groins as large as hazel nuts, and some as large as lentils in the mesentery. The spleen was full of pseudo-tubercles, and all the organs contained plague bacilli.

Guinea pig No. 4. On December 15, fourteen days after defervescence, a guinea pig was injected in the peritoneal cavity with 1 c. c. of sputum. The animal did not sicken and was left in good health on January 20.

III. Lobo.—Plague with pulmonary complications. On November 21 the sputum contained plague bacilli which were virulent for a guinea pig, causing death in four days. Apyrexia on November 26.

Guinea pig No. 6. On December 2, seven days after convalescence, 1 c. c. of the sputum of this patient was injected into the peritoneal cavity of a guinea pig, and the animal died on the sixth day with all the symptoms of plague. The plague bacillus was found in all the organs and the spleen was full of pseudo tubercles.

Guinea pig No. 7. The same experiment was repeated on December 11, seventeen days after defervescence. The animal remained well.

Guinea pig No. 8. On December 18 a guinea pig was given 1 c. c. of the sputum of the patient and remained well.

IV. Leop. Gomez.—A very grave case of plague, not treated by serum. Bacilli in the sputum on December 1, which killed a guinea pig in three days. Apyrexia on December 23.

Guinea pig No. 9. On December 30, seven days after defervescence, 1 c. c. of the sputum of the patient was given intraperitoneally to a guinea pig. The animal died in three days with all the ordinary lesions of plague, and plague bacilli were recovered from all the organs.

Guinea pigs Nos. 10 and 11. These animals received 1 c. c. of the sputum of the patient on January 6 and 13, respectively, fifteen and twenty-one days after defervescence. No departure from the normal was observed.

V. Alb. Cardose.—A grave case of plague, not treated by serum. On December 6 the sputum contained plague bacilli, and killed a guinea pig in four days. Apyrexia on December 20.

Guinea pig No. 12. Inoculated as usual on December 28, eight days after defervescence. The animal died in seven days with all the lesions of plague.

Guinea pigs Nos. 13 and 14. Inoculated respectively on the fourteenth and twentieth days after defervescence, and no departure from normal was noted.

VI. Grac. Maria.—Plague of ordinary severity, not treated by serum. Plague bacilli found in the sputum December 9, which killed a guinea pig in five days. Apyrexia December 20.

Guinea pig No. 15. Died in six days after the intraperitoneal inoculation of 1 c. c. of sputum given seven days after defervescence. At necropsy all the lesions of plague and bacilli in all the organs.

Guinea pigs Nos. 16 and 17. Remain well notwithstanding the intraperitoneal inoculation of 1 c. c. of sputum on the tenth and twenty-first days of convalescence.

VII. Carolina.—Primary plague pneumonia, not treated by serum.

Plague bacilli in the sputum on December 9 and apyrexia on December 19.

Guinea pig No. 18. Inoculated in the peritoneum with 1 c. c. of sputum, seven days after defervescence. Died in six days and the plague bacilli were recovered from all the organs.

VIII. Philomele.—Primary plague pneumonia. Presence of plague bacilli demonstrated in the sputum December 9. Apyrexia December 21.

Guinea pig No. 19. On December 30, nine days after apyrexia, a guinea pig was inoculated intraperitoneally with 1 c. c. of the sputum of the patient. The animal appeared slightly sick for two days with loss of appetite and activity, but without fever, and there were no buboes. The animal was completely well within four days after inoculation, and blood taken during the two days of sickness showed no organisms whatever.

From these experiments we may draw the conclusion that if the plague bacilli *do* remain virulent in the sputum of patients who have had pulmonary complications even up to the eighth day after defervescence, and when auscultation reveals no further trouble in the lung, this virulence is nevertheless somewhat diminished, since they only kill a guinea pig in five to seven days instead of in three to four days. Further, from the ninth day on, after the return of apyrexia, the inoculation of this sputum into the peritoneum of animals does not cause death. We, therefore, may consider the sputum of patients as harmless when ten days have elapsed after the entire disappearance of the fever and the disappearance of physical signs. We should say here that during the eight or nine days that the sputum is fatal to guinea pigs, we have never been able to find in it the plague bacilli by microscopic examination of direct preparations. (This would indicate that cultivation or inoculation experiments were *necessary* to prove their existence in the sputum during this period.—Trans.)

The persistence of the plague bacilli in the sputum, and their virulence during the early days of convalescence, are facts of extreme importance from the point of view of the dissemination of the disease, and at the same time might be the cause of the reinfection of the patient himself. In plague buboes the bacillus may also remain a certain length of time; in some cases we have noted a true relapse of the disease in subjects who had been considered as cured. Two of these patients died late of cerebral complications due to the plague bacillus, which after having slumbered, so to speak, without causing any trouble during convalescence, took on a renewed vitality. These are cases of relapse rather than of reinfection.

Up to the present time, in fact, we know of but very few authentic cases of reinfection in plague. The reason for this nonreinfection appears to us to be an interesting study, and to this end we have studied the properties of the blood of cured patients. We chose patients who had not received treatment by the antipest serum. Three patients were willing to authorize us to take a certain quantity of blood from their veins. They had been stricken with plague without pulmonary complications, one of them a mild case, two others with a grave form.

The small quantity of blood which we were enabled to procure did not permit us to make absolutely complete experiments. On the other hand, the patients who were willing to furnish us blood had already entered into convalescence when we arrived in Oporto. We were not able, therefore, to experiment on the properties of their serum against the identical microbes which had caused their illness. Nevertheless we think it may be useful to detail the results of our experiments, imperfect though they may be.

I. Jose D.—Mild plague; gives 10 c. c. of blood, from which we secured about 5 c. c. of serum.

Guinea pig No. 1. Received 1 c. c. of the serum subcutaneously, and on the following day subcutaneously one-half of a cubic centimeter of a twenty-four-hour old bouillon culture of B. pestis, which in the same dose killed the control guinea pig in three days. The animal survived.

Guinea pig No. 2. Received subcutaneously one-half of a cubic centimeter of plague culture as above, and on the following day 1 c. c. of the serum. This pig was sick for five days, with buboes in the groins, fever, and loss of appetite, but after this time complete recovery ensued.

II. Frederico B.—Grave plague, 10 c. c. of blood, 5 c. c. of serum.

Guinea pig No. 3. We injected this pig subcutaneously with 1 c. c. of the serum, and on the following day with one-half of a cubic centimeter of a bouillon culture of B. pestis, which killed the control pig in three days. This pig appeared sick for the first two days, nevertheless we felt no buboes and the animal had no fever. It recovered completely.

Guinea pig No. 4. Twenty-four hours after injecting one-half of a cubic centimeter of culture as above, 1 c. c. of serum was injected. This pig died in ten days. There was considerable œdema at the point of inoculation, buboes in the groins, spleen enlarged. All the organs contain large and long plague bacilli.

III. Antonio C.—Grave plague, 15 c. c. of blood, 6 c. c. of serum. Guinea pigs Nos. 5 and 6. The same experiments to determine the preventive and curative properties of the serum were made upon these pigs. While the control died in three days, both these pigs lived.

With the friendly assistance of Dr. Dujardin-Beaumetz, we made another series of experiments at the Pasteur Institute, using mice, an animal more sensitive to plague than the guinea pig. The plague bacilli used in these experiments were a culture called "Djeddah," inoculation with which killed a control mouse in sixty hours, and the bacillus "Reunion," which killed its control in forty-eight hours.

I. Serum of José D.—Mouse No. 1. Injected subcutaneously one-half of a cubic centimeter of the serum and on the following day an inocula tion of B. "Djeddah." The mouse died in seven days, a prolongation of life of four and one-half days.

Mouse No. 2. One cubic centimeter of serum injected twenty-four hours before an inoculation of B. "Reunion." Died, with a prolongation of three and one-half days.

Mouse No. 3. Injected with the B. "Djeddah," and on the following day with one-fourth of a cubic centimeter of the serum. Died in eight days, a prolongation of five and one-half days.

Mouse No. 4. An inoculation of "Djeddah" and on the following day one-tenth of a cubic centimeter of the serum. Died with a prolongation of forty-two hours.

Serum Antonio C.—Mouse No. 5. A dose of one-half of a cubic centimeter of this serum followed on the next day with an inoculation of B. "Djeddah." Mouse died in fifteen days, a prolongation of thirteen days.

Mouse No. 6. Injected with 1 c. c. of serum, and twenty-four hours after inoculation with B. "Reunion." Lived fifteen days, a prolongation of thirteen days.

Mouse No. 7. One-tenth of a cubic centimeter of serum only retards for forty-two hours the death of a mouse which had been previously inoculated with the culture "Djeddah."

III. Serum Frederico B.—Mouse No. 8. Received one-half of a cubic centimeter of this serum, and twenty-four hours after was inoculated with the culture "Djeddah." It died in ninety hours, a prolongation of thirty hours.

Mouse No. 9. Injected 1 c. c. of this serum and on the next day inoculated with the culture "Reunion." The prolongation of life was three and one-half days.

These experiments show that the serum of patients who have recovered from the plague naturally—*i. e.*, without having received serum treatment, has slightly preventive and even curative properties. In the guinea pig we have always observed, save in a single instance, the survival of the animal under experiment, whether the serum had been used in a preventive or curative fashion. If the same does not hold good in the case of mice it is due either to the greater susceptibility of this animal to the plague bacillus, or to the long time during which the serum was kept before renewing the experiments. Though the serum was kept in tubes sealed in the flame, it is possible that the three months which elapsed between the taking of the blood and the experiments may have attenuated the properties which it had shown in our guinea pig experiments.